

Continuity in Intellectual Functioning: The Role of Self-Reported Health

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Surviving members of the Berkeley Older Generation Study were interviewed and tested with the Wechsler Adult Intelligence Scale in 1969-1970 and again in 1983-1984, when subjects' ages ranged from 73 to 93. Health was assessed by self-reports at both measurement periods. Although many individuals showed some decline in intellectual functioning, substantial individual differences were apparent at all age levels. More than one half of the subjects showed no reliable change, and a minority showed a reliable increase in verbal scores. The role of self-reported health has increasing importance in the maintenance of intellectual functioning in advanced old age.

Longitudinal studies have shown that intellectual functioning is associated with physical health, as for example, in the National Institute of Mental Health (NIMH) Human Aging Study (Botwinick & Birren, 1963). For members of the Bonn Longitudinal Study of Aging (Rudinger, 1976), health was an "essential source of performance decrease in old age" (p. 33). Jarvik and Bank (1983, p. 48) found that "critical loss" in IQ scores predicted death for a significant proportion of aging twins. Although the longitudinal relation of cardiovascular disease and decreased functioning in both younger (Busse & Maddox, 1985; Sands, 1986) and older adults (Hertzog, Schaie, & Gribbin, 1978; Shock et al., 1984; Wilkie & Eisdorfer, 1971) has been studied most often, other infirmities such as arthritis, poor vision, and deafness also can contribute to decline in the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1955), particularly in the speeded Performance subtests (Sands, 1986). Schaie (1983) found age differences in the association of health with ability scores in the Seattle Longitudinal Study; only the older groups showed a relation between health and change in intellectual functioning over 7 years. Thomae (1976) suggested that health may be the most decisive causal factor in cognitive decline, but

the evidence so far is not conclusive and age-related changes continue to require study and explanation.

Longitudinal studies of cognitive functioning have shown that few normative changes occur until the late 60s; after that age, substantial decrement occurs for many, but not all individuals (Schaie, 1979, 1983). Most such studies have found little or no decline in test scores into young-old age (Jarvik & Bank, 1983; Owens, 1966; Rudinger, 1976). In old-old age, however, intellectual decline has been found for many, as a larger proportion of the subjects approached the period of terminal drop (Kleemeier, 1962; Riegel & Riegel, 1972). Nevertheless, the initially more able were likely to show a slower rate of decline (Blum & Jarvik, 1974; Schaie, 1979). Longitudinal studies that have examined individual differences (Field & Schaie, 1985; Schaie, 1983, 1984) have shown that even in advanced old age, substantial individual differences continue to be found, paralleling those observed at earlier ages.

Because cognitive decline is not necessarily dependent on age, other influences, such as health, must be explored. In particular, cognitive and health declines of the oldest segment of the population deserve attention. Most gerontologists now agree that the elderly do not form a monolithic group. Neugarten (1974) suggested that those 60 to 75 years old should be considered young-old, for they are more like middle-aged persons in personal and social resources. The old-old, aged 75 and over, were said to face much more difficult problems of health, constricting social relationships, and increasing dependency. Another subgroup of the elderly, the very-old, those aged 85 and over, have recently received attention (Longino, 1986; Siegel & Taeuber, 1986; Suzman & Riley, 1985). Very little is yet known about this oldest segment of the elderly, although they are the fastest growing group in the United States (Siegel & Taeuber). The greatest decline in cognitive functioning is likely to be

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found among them, and perhaps also the strongest relation between cognitive functioning and health. Although studies have repeatedly shown that heterogeneity increases with age (Maddox, 1987), very little is known about stability and change in the attributes of the old-old and the very-old.

Few studies have compared the health of the very-old with that of younger old persons, but a "dramatic and significant" increase in functional limitation has been reported for those over age 85, even compared with those aged 80 to 84 (Cornoni-Huntley et al., 1985, p. 351). Longitudinal studies have shown that a decline in health does occur in advanced old age and cannot be attributed merely to cohort differences, although there was a "remarkably limited amount of change" in the survivors of the NIMH study after 11 years (Granick & Patterson, 1971, p. 132). Stability in health status over a shorter term was found in the first Duke Longitudinal Study (Heyman & Jeffers, 1970), for approximately 75% of the participants remained in the same health category for 3 years or more, whether the health rating was obtained from a physician or from self-report.

This article examines continuity or change in cognitive functioning during advanced old age, continuity or change in self-reported health across the same period, the relation between these two constructs, and how these relations differ for individuals who are old-old or very-old.

Three hypotheses guided this research: First, although there is on average a decline in intellectual functioning, marked individual differences in age changes will be found. Second, decline in self-assessed health will be found on average, especially among the oldest participants, but individual differences will be found in this area, as well. Third, the association between intellectual functioning and self-assessed health is explored with three subhypotheses: (a) Self-assessed health will be associated with intellectual functioning in old age, but the relation will be stronger for the oldest persons; (b) self-assessed health at the first measurement period will predict intellectual functioning at the second period; and (c) change in intellectual functioning will accompany change in self-assessed health.

Method

The Sample

The Berkeley Older Generation Study at the Institute of Human Development, University of California, Berkeley, comprises the surviving parents of the original Guidance Study and Berkeley Growth Study children (Bayley, 1933; Maas & Kuypers, 1974; Macfarlane, 1938). These men and women were interviewed when their children were born in 1928 and 1929; approximately 17 (1945-1947), 40 (1968-1969), and 54 (1982-1984) years later, most of the surviving parents were again interviewed and tested. The data presented here are taken from the 1968-1969 (hereafter called 1969) and the 1982-1984 (hereafter called 1983) follow-up studies. The mean age of the study members was 69.0 years in 1969 and 82.7 years in 1983. At the time of the 1983 follow-up, 61 members were 74 to 84 years old, thus in the old-old category, and 29 were 85 to 93 years old, thus in the very-old category.

At the beginning of the study in 1929, the Guidance Study parents were a representative sample of the young-adult parent population of Berkeley, inasmuch as their children were a sample of every third baby born in Berkeley during those two years (1928 and 1929). The smaller Berkeley Growth Study group was recruited from a middle-class sample whose children were born in hospitals during the same years. The par-

Table 1
Comparison of the Berkeley Older Generation Study With the 1980 1-in-20 Public Use Microdata Sample From the United States Census Bureau (Longino, 1986)

Variable	Old-old		Very-old	
	Berkeley group	National sample	Berkeley group	National sample
Living situation				
Living alone	33.3	34.6	24.1	29.7
Living in an institution	8.2	7.7	20.8	24.4
Living with a child*	6.6	8.1	13.7	16.4
Marital status				
Divorced	4.6	3.2	3.5	2.1
Widowed	52.3	48.6	65.5	70.0
Married	43.1	41.7	31.0	20.7
Never married	0.0	6.5	0.0	7.2
Sex				
Female	68.9	63.1	65.5	69.2
Education				
1+ years of college	52.5	14.6	69.0	12.8

Note. All of the figures are percentages.
* All of the Berkeley group have a child.

ents were similar to their national census cohort of the time, in most respects. As might be expected in a college town, however, they had more education and used more labor-saving devices in their homes; nevertheless, their incomes were lower than the national cohort (Macfarlane, 1938).

Approximately 20% of the original parents survived to be interviewed in 1983 as members of the Berkeley Older Generation Study. The influence of selective attrition in longitudinal studies must be considered, inasmuch as it may yield a sample with higher mental-ability levels than in the original sample (Baltes, Schaie, & Nardi, 1971). A comparison of the ratings made in 1929 by Macfarlane (1938) and colleagues of the Berkeley Older Generation Study women indicated that the surviving women were rated somewhat higher than were the nonsurvivors, in intelligence, $t(226) = 2.13, p < .05$, and in mental alertness, $t(226) = 2.32, p < .05$, but not in use of language, $t(226) = 1.91$. (The men were not rated.) Other studies have shown that after early attrition occurred, subsequent attrition was minor and did not alter the basic distribution of ability (Gribbin & Schaie, 1979; Siegler & Botwinick, 1979). This was the case for the Berkeley survivors, as well. No differences were found between the 1969 WAIS scores of those who survived to be interviewed in 1983 and the nonsurvivors, on Verbal, $t(121) = .17$, or Performance, $t(117) = -.77$, WAIS scores. When the Berkeley survivors were compared with their cohort in the 1980 U.S. Census (Longino, 1986), no differences were found in sex, marital status, or living situation, although they did differ in education, as shown in Table 1.

Only one half of the 1969 sample was still available for interviewing in 1983. Of those who were not available, 89% had died, 3% were in nursing homes and incapable of being interviewed, 4% could not be contacted, and 4% refused to be interviewed because of ill health. After being interviewed, but before WAIS testing began, an additional 13% of the group died. Of the 57 participants who were interviewed and tested on both occasions, 23 (16 women and 7 men) were very-old at the time of the second testing. The average age of the very-old subgroup was 88.8 years; the youngest were 85 years old, and 6 were 90 to 93 years old. The 34 old-old participants included 25 women and 9 men; their average age was 80.6 years, and the youngest was 74 years old. Although our sample is small, the Berkeley Older Generation Study spans more than 50 years and includes the largest number of very old people who have

been studied over a long period of time (Jarvik & Bank, 1983; Schaie, 1983; Siegler, 1983).

Interviews and Ratings

In 1969 and again in 1983, each study member was interviewed individually in his or her own home by a psychologist or clinical social worker who had no prior knowledge of the interviewee. The interviews were open-ended and intensive; in addition to the content described in detail later, they were asked about family relationships, marriage, social support, social relationships, occupations and leisure activities, and their recollections of the past. The interviews usually lasted from 4 to 6 hours and often included two sessions. Because the participants had known and trusted the Institute of Human Development for 40 to 55 years, the interviews were unusually open and self-disclosing. These 1969 and 1983 protocols were rated by a well-trained team of raters; each interview was read independently by two raters. All ratings were blind; that is, at no time did a rater read any interview of a person about whom he or she had any prior knowledge. Because many of our scales were nominal or ordinal, reliability coefficients could not be computed; instead, percentage agreement between raters was determined for each interview. Any discrepancy in ratings was counted as a difference; all differences were discussed by the raters, and agreement on each was reached in conference. Before conferring, interrater agreements averaged 75% and 79% for 1969 and 1983, respectively; after the conferences, of course, agreement approached 100%.

Measures

Intelligence. The measure of intellectual functioning was the WAIS, which was administered in 1969–1970 and 1983–1984 to most of the surviving study members. Results are reported separately for the Verbal and Performance scale scores.

Health. Throughout this article, *health* refers to a health index composed of self-report measures, not to clinical assessments by physicians. Many researchers have shown that self-reports are positively associated with more formal health measures, such as physicians' ratings (Ferraro, 1980; LaRue, Bank, Jarvik, & Hetland, 1979; Liang, 1986; Maddox & Douglass, 1973), yet self-reports can be affected by depression (Elias, Robbins, Blow, Rice, & Edgcomb, 1982) or by neuroticism (Costa & McCrea, 1985). In the Bonn Longitudinal Study, physicians' ratings were more predictive of some mental scores than were self-reports of health, yet self-reports proved to be the better predictors of subsequent survival (Lehr, 1983).

The health index was constructed from four variables, each of which was measured as part of the 1969 and 1983 interviews. Three variables were the following self-report measures: "How would you say your health is, these days?"; "Has your health had any effect on your level of activity?"; and "How is your health now, compared with your 40s(60s)?". The fourth variable was a rating of energy made by two raters on the basis of self-report information contained throughout the interview. The responses to these four variables were summed to form the health index. Reliability of this index, measured by Cronbach's alpha, was calculated for both measurement periods. For the old-old, alpha was .77 for the first period and .81 for the second. Alpha was even higher for the very-old: .82 for 1969 and .89 for 1983.

Plan of Analysis

The analyses reported here are of three kinds. Hypothesis 1, related to change over time in intelligence, was tested by means of 2×2 (Old-Old vs. Very-Old \times Measurement Times) ANOVAs with repeated measures. For all significant effects, planned comparisons were carried out to determine precisely how the groups differed. In addition, intraindivi-

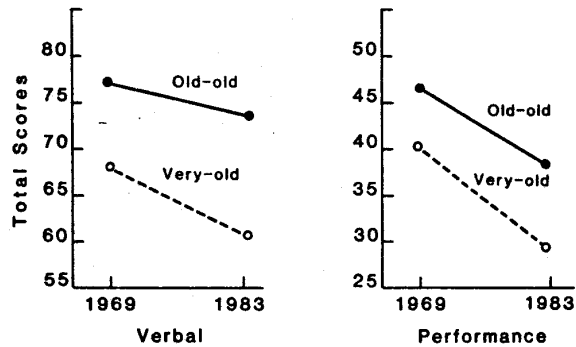


Figure 1. An over-time comparison of Wechsler Adult Intelligence Scale Verbal and Performance scores for the old-old and very-old groups.

vidual change in intelligence was examined by computing reliable change as determined by calculating the confidence band of one standard error of measurement (1 SEM) about the observed scores in the first test (Dudek, 1979; Field & Schaie, 1985; Schaie, 1984). Only those individuals whose change exceeded 1 SEM in verbal or performance scores were deemed to have shown nonrandom, reliable change. This procedure allowed for an investigation of interindividual differences in intraindividual change. Hypothesis 2, related to change over time in health, also was examined with 2×2 repeated measures ANOVAs, planned comparisons, and an assessment of reliable individual change. Finally, Hypothesis 3 was tested with a series of hierarchical multiple regression equations to examine the influence of sex, age, and health on WAIS Verbal and Performance scale scores at each time of measurement. Because we predicted decline in WAIS scores and in health, one-tailed tests of significance were used in all of the analyses.

Results

Intellectual Functioning

Wechsler Adult Intelligence Scale. The Berkeley Older Generation Study members were above average in intelligence; their WAIS total IQs averaged 119 at each testing, with a normal distribution around this high mean. The range for these survivors was 85 to 150 in 1969 and 92 to 158 in 1983. The WAIS IQs, however, are adjusted for age (Doppelt & Wallace, 1955; Wechsler, 1955). Because our concern is with continuity or change, not with the maintenance of relative position within an age group, we examined the overall Verbal and Performance scales, for these are not age adjusted.

Interindividual change. Figure 1 shows the Verbal and Performance scores of both age groups at both measurement periods. In 1969, the Verbal scores of the old-old were $M = 75.7$, $SD = 13.9$, and range = 32–104, and the very-old group's scores were $M = 68.8$, $SD = 13.0$, and range = 44–93. In 1983, old-old Verbal scores were $M = 69.7$, $SD = 16.6$, and range = 34–108, and $M = 60.8$, $SD = 15.5$, and range = 35–92, for the very-old. Two-way (Age \times Time) ANOVAs with repeated measures were used to analyze change in these scores. Verbal scores changed strongly over time, $F(1, 54) = 23.96$, $p < .001$, with an age-group difference, $F(1, 54) = 8.62$, $p < .01$, as well. An age-by-time interaction, $F(1, 54) = 3.71$, $p < .05$, revealed that the decrease in verbal scores was greater for the older persons. Al-

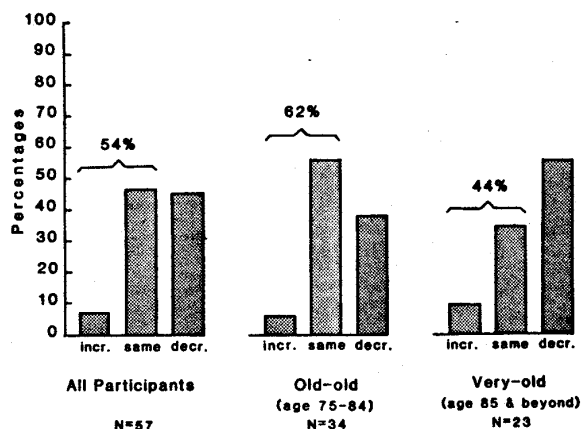


Figure 2. Reliable change in Wechsler Adult Intelligence Scale Verbal scores over 13 years of late life.

though there were no differences in means between the old-old and the very-old in 1969, significant group differences appeared in 1983 Verbal scores, and the scores of the very-old were significantly lower in 1983 than in 1969. The proportion of decliners was comparable with that found in the Seattle sample (Schaie, 1984).

In 1969, the old-old Performance scores were $M = 46.1$, $SD = 8.5$, and range = 29-69, whereas very-old scores were $M = 42.0$, $SD = 8.6$, and range = 26-57. In 1983, old-old Performance scores were $M = 37.3$, $SD = 10.5$, and range = 17-58, and $M = 29.1$, $SD = 7.2$, and range = 11-42 for the very-old. The Performance scores revealed an even greater change, $F(1, 48) = 125.52$, $p < .001$, and a significant difference in means between the old-old and very-old age groups, $F(1, 48) = 10.96$, $p < .01$. The two age groups did not differ significantly in their scores in 1969, but in 1983 the very-old were lower than the old-old in Performance scores, and the very-old were lower in 1983 than they had been in 1969.

For the group as a whole, then, decline in verbal and performance intelligence was found, and the decline was selectively greater for the very-old. This confirmation of previous research findings refers, of course, to group differences. The second focus for this research was on individual differences in amount of change versus stability.

Intraindividual change. In common with other longitudinal studies of aging persons (e.g., Schaie, 1983; Siegler, 1983), we found marked longitudinal consistency in WAIS scores, for cross-time correlations for all participants were .86 for the Verbal scores and .83 for the Performance scores. For this group, individual change was considered to be reliable if it exceeded 1 SEM, (5 points in the Verbal score and 3 points in the Performance score).

Figure 2 shows the proportion of individuals experiencing reliable change in the Verbal scores. Reliable decline was found in many, of course, but more than one half of the total group remained stable, and a minority showed reliable increase in Verbal scores. The most important finding is that 44% of the oldest group (aged 85 to 93) did not experience reliable decline

in Verbal scores, and 62% of the younger group (aged 74 to 84) showed no reliable decline.

The Performance score results, shown in Figure 3, reveal that decline here was far more pervasive: No study members showed reliable increase, and only 6% of the very-old and 15% of the old-old remained stable. All others declined.

Self-Reported Health

Interindividual change. Figure 4 presents the health index scores for both age groups at both measurement periods. The health index score had a possible range from *very good* (4) to *very poor* (20). The actual range at Time 1 was 5 to 18, $M = 8.6$, and $SD = 3.01$; at Time 2, the range was 5 to 20, $M = 11.1$, and $SD = 3.92$.

A two-way (Age \times Time) ANOVA of health with repeated measures over time showed that the main effects of time, $F(1, 52) = 17.59$, $p < .001$, and of age groups, $F(1, 52) = 3.68$, $p < .05$, were significant. The age-by-time interaction, $F(1, 52) = 4.65$, $p < .05$, showed that the cross-time trajectories of the two were different. The very-old had significantly poorer health than the old-old only at the second measurement, and decline in health was greater for the very-old than for the old-old.

Intraindividual change. The cross-time correlation of the health index was fairly high at .57, although not as high, of course, as that found for the WAIS. Reliable change in the health index was assessed by determining the 1-SEM confidence interval. The least change that was deemed reliable was 3 points. Among the old-old group, 21% declined in health, 73% showed no significant change, and 6% (1 man and 1 woman) actually increased reliably in self-reported health. In the very-old group, 35% declined, 65% showed no change, and none increased. Although the very-old perceived themselves to be in poorer health than did the old-old, the difference between the two age groups in proportions that showed significant amounts of change and direction of change was not significant, $\chi^2(1 N = 57) = 2.31$. More than one half of the group reported no reliable decline in self-assessed health.

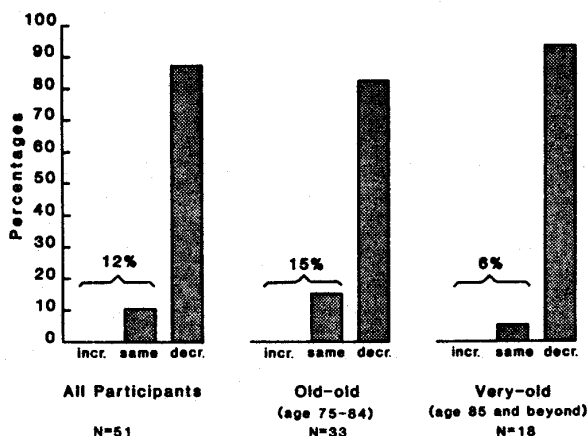


Figure 3. Reliable change in Wechsler Adult Intelligence Scale Performance scores over 13 years of late life.

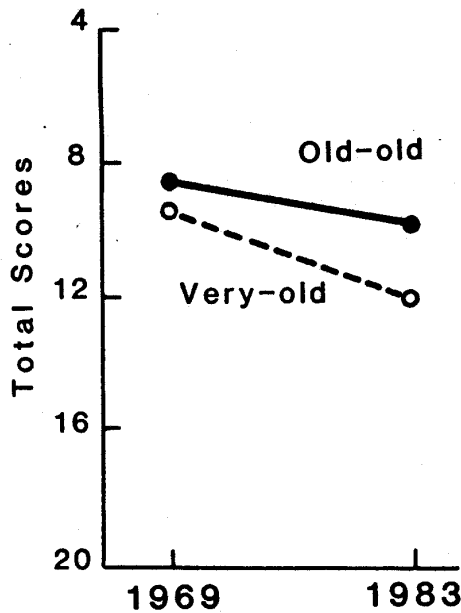


Figure 4. An over-time comparison of health index scores for the old-old and very-old groups. (Smaller numbers indicate better health.)

Relation Between Intellectual Functioning and Self-Reported Health

Are health and intellectual functioning related at each measurement period? Hierarchical multiple regression analyses were used to predict intellectual functioning from health within each measurement point. Because age differences (described earlier) and sex differences (men's 1969 Verbal scores were higher than women's, $t(47) = 2.18, p < .05$) were found, it was necessary to control for their effects in order to understand the role of health. Sex, age, health, the interaction of health and sex, and the interaction of health and age were entered into each equation in that order. The interaction terms reached significance in none of the equations.

As Table 2 shows, sex and age accounted for significant percentages of the variance in cognition in 1969 and in 1983. Once these influences were accounted for, in only one of the four instances did health show a significant relation to cognition. At the final test, age and health together explain nearly one third of the variance in the Performance scale scores. Because the zero-order correlations were significant in three cases, it appears that age and health were to some extent reflecting similar variance contributions to cognitive functioning.

Does health predict subsequent intellectual functioning? Can we use the measurements made some 14 years earlier to predict intellectual functioning in old age? This possibility was tested using hierarchical multiple regression models in which 1983 WAIS scores were regressed on sex, age, and 1969 health, in that order. In the regression model for Verbal scores, only the equation adding age to sex showed a significant contribution to the prediction of later cognitive functioning ($R^2 = .17, R^2$

change = .12), $F(2, 46) = 6.78, p < .05$. In the Performance model, the effect of adding age to sex was far stronger ($R^2 = .32, R^2$ change = .25), $F(2, 42) = 15.20, p < .001$. In neither case did 1969 health predict 1983 cognition independently of age. As was noted previously, the best predictors of WAIS scores in old-old or very-old age were WAIS scores in young-old age, for their zero-order correlations were .86 for Verbal and .83 for Performance scale scores.

Does change in health predict change in intellectual functioning? To answer the question of whether change in health predicts change in intellectual functioning, a model was devised whereby change in independent variable (health) and dependent variable (intellectual functioning) could be related, after controlling for all relevant effects that had been previously measured. First, 1983 Verbal scores were residualized through a regression model in which sex, age, 1969 Verbal, 1969 Performance, 1969 health, and the Health \times Sex and Health \times Age interaction terms were forced into the equation in that order. The resulting residual score was an indication of the individual's change in Verbal scores relative to the sample as a whole, after the effects of all other variables were accounted for. Second, 1983 health scores were similarly residualized by forcing sex, age, 1969 health, 1969 Verbal, and 1969 Performance into the equation, yielding a health residual. Finally, the verbal residual score was correlated with the health residual score, and the resulting scatter plots were examined.

The verbal residual scores ranged from an excess of 18.8 to a deficit of 24.2. The partial correlation of verbal residual with health residual was only .08, indicating that after other influences were controlled for, change in health did not predict change in verbal intellectual functioning for the group as a whole.

But we are also concerned with individual differences. It is important to examine the outliers, individuals whose change scores were more extreme than those of the rest of the group. The standard error of regression (SER) was used to identify the outliers. The verbal residual scores of most of the study members fell within 1 SER (which in this case was 7.9) above or below the regression line, but there were 6 outliers whose verbal scores fell above the SER line, indicating that they increased relative to other participants more than expected when age, sex,

Table 2
Multiple Regression Models Predicting Intellectual Functioning in Advanced Old Age

Variable	Verbal score				Performance score			
	<i>r</i>	β	R^2	<i>F</i> (change)	<i>r</i>	β	R^2	<i>F</i> (change)
1969								
Sex	.30*	.30	.09	4.74*	.27*	.27	.08	3.49
Age	.28*	.31	.19	5.28*	.25*	.29	.16	4.07*
Health	.24*	.18	.22	1.82	.23	.18	.19	1.71
1983								
Sex	.14	.14	.02	1.14	.28*	.28	.08	4.29*
Age	.36**	.38	.16	9.10**	.30*	.32	.18	6.09*
Health	.25*	.14	.18	1.10	.40**	.31	.27	5.50*

* $p < .05$. ** $p < .01$.

health, and previous Verbal scores were taken into account, and 4 outliers who declined more than expected.

The procedure described earlier was also followed with the Performance scores. The partial correlation of health residuals and performance residuals, although greater ($r = .22$), was still not significant. The performance residual scores ranged from an excess of 11.1 to a deficit of 11.7. For most people, the "increase" in performance residuals was in fact a smaller-than-expected decrease. As described earlier, no Performance scores increased reliably. Nevertheless, 4 study members had performance residuals that exceeded, and 7 members had residuals that fell below what was expected from their age, sex, health, and prior Performance score, that is, by more than 1 SER (5.4).

Searching for explanations, we examined the 1969 and 1983 protocols of all outliers. A total of 17 individuals were outliers: Four persons appeared as outliers in both verbal and performance residual equations, 2 as increasers, and 2 as decliners. These protocols revealed that for most of the outliers, health was strongly implicated. For 7 persons (41%) their own worsening health was accompanied by extreme decline in Verbal or Performance scores, or both. In fact, 4 of these outliers have since died, and 2 are hospitalized with Alzheimer's disease. For 3 persons (18%), stable or increasing WAIS scores were associated with stable or relatively increasing health. A considerable increase in WAIS scores was found in 6 persons (35%) who in 1969 were caring for an ill spouse who by 1983 had died. As a result, the surviving spouse was freed to take on new activities and interests, yielding increased scores. All performance increasers and 2 verbal increasers were in this category. Another factor that appeared to inhibit cognitive functioning for 2 outliers (12%) was depression, which may have been associated with an unrecognized decline in health. One woman (6%), although declining in health, greatly increased her verbal residuals. Reading the case protocols yielded no clear-cut explanation. She was 87 and still fiercely independent; in spite of physical infirmities, she continued her activities, read widely, and saw friends daily. Perhaps this continuing interest in the world at such an advanced age is what maintained her verbal abilities and made her an outlier.

It will be noted that the sum of the percentages is greater than 100%. Three persons appear in two categories: While their spouses were gravely ill, their own health also was depressed. On close inspection, then, it appears that health—of self or spouse—was indeed an important factor in change in cognitive functioning and was implicated for 16 of the 17 outliers.

Discussion

The stereotype of inevitable decline in intellectual functioning in midlife and beyond has in general not been supported by the results of longitudinal research. There are, of course, important changes in intellectual functioning in advanced old age, but there also is impressive continuity in many persons.

The similar stereotype of inevitable frailty in old age also is yielding in the face of evidence from longitudinal studies. Although decline in health may be almost inevitable preceding death, poor health throughout old age most certainly is not. Among the Berkeley group, as was true in the Seattle study (Schaie, 1983), health was more clearly associated with intellec-

tual functioning for the oldest participants, and Performance scores were more strongly related to health than were Verbal scores.

For the Berkeley group as a whole, the change in self-reported health from 1969 to 1983 was not as severe as the change in Verbal or Performance scores over the same period, as shown in Figures 4 and 1, respectively. This may result in part from the different manner in which the information was obtained. The WAIS is a standardized test, with the same items presented in the same way at both measurement points. The health construct, on the other hand, was composed of self-reported variables and was subject to the perceptions and expectations of the study members.

Self-reports of health may place greater emphasis on functions performed, such as amount of independence and scope of daily activities, than do physicians' assessments (Engle & Grane, 1985-86; Lehr, 1983). Some gerontologists have urged, therefore, that health status in the elderly ought to be redefined in terms of functional ability and autonomy (Minkler, 1985). Self-assessments of health may be influenced by comparison with their peers (Stoller, 1984). According to reference group theory, self-assessments depend on the individual's comparison group; thus, health aspirations may decline with age, and less "health" is required for the elderly person to feel satisfied with actual health status (Levkoff, Cleary, & Wetle, 1987). Essex (1986) suggested that self-assessments of health are a function of objective health, functional impairment, and mediating variables such as social isolation and location in the social structure, especially as denoted by the age and sex of the reporting persons. She reported that young-old and old-old women attached different meanings to health and functional impairment because of differences in the reference groups with which they compared themselves.

Not all self-reports of health are reliable, of course, as the Bonn (Lehr, 1983) and Duke (Maddox, 1987) studies also found. For example, in the Berkeley study, two members, a man and a woman, both more than 90 years old, reported good health that was unrealistic even in terms of reference group theory. Had they been more realistic, the correlations of health and performance scores would have been higher. Yet one of the advantages of the residual multiple regression equations is that these two persons were identified as outliers, and a perusal of their case protocols revealed that their health had in fact declined almost as precipitously as their WAIS scores. For the most part, however, self-reports reflected the true conditions, as we can attest on the basis of our long-time knowledge of these persons and on their subsequent history. For example, the two who reported the worst health died before 6 months had passed, and those study members who died within 4 years reported significantly poorer health in 1983 than did those who survived.

Self-assessed health was not found to be as strong a correlate of cognitive functioning as was anticipated. However, for almost all of the outliers, observer reports based on the case protocols strongly implicated the subject's own or the spouse's health as a factor in cognitive change. This indicated that two health variables that were not included in the plan of analysis, namely observers' reports of health and spouse's health, accounted for individual differences and improved predictions of cognitive functioning. These variables are not often used, but should be.

Satariano, Minkler, and Langhauser (1984) found that having a spouse in poor health exerted a depressing effect on the self-reported health of the caregiving spouse. The Berkeley study suggests that cognitive functioning is also affected by the stress of caregiving. In addition, widowhood, and its release from the burdens of caregiving, apparently also created an opportunity for new activities and an increased level of functioning for these Berkeley study men and women.

Sex differences in WAIS scores found in our study are similar to differences found in the Bonn study (Rudinger, 1976)—in which men's Verbal scores decreased over time, whereas women's were stable—yielding only a slight difference by the final measurement. The women of the Aging Twins Study (Jarvik & Bank, 1983) exceeded the men in verbal ability, suggesting that senescent men decline more rapidly than the women. An interaction of sex and ability was found in the Seattle study; women declined first on the active abilities, whereas men did so on the passive abilities. Schaie (1983) suggested that sex differences in patterns of socialization may have been the major determinant of this effect.

Studies of age changes in health and cognition have typically focused on group differences. Although there is indeed a great deal of stability in the trajectory of intellectual functioning into old age, individual differences have nevertheless been found to be of salient importance when they were searched out (Schaie, 1983, 1984, 1988). In this article we have shown that although health became more important in the maintenance of intellectual functioning as age increased, individual variations in health and in intellectual functioning continued to be great, and the impact of health differed depending on other life circumstances.

We have shown that although measures of central tendency found decline in WAIS scores and in health for the group as a whole, an examination of individual persons revealed a substantial number in each group who did not decline, even at the oldest age levels. We also have shown that although the relation between intellectual functioning and health was weak for the group as a whole, an examination of individual outliers revealed that for those whose change in cognitive functioning was extreme, health was commonly implicated. It is important not to forget the individual member of the group. This is particularly true in an area in which stereotypes abound, causing many old people to resign themselves to "inevitable" decline. The danger is that adherence to these stereotypes may lead to suboptimal aging.

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